

What is claimed is:

1. A method of shielding the effluent of a thermal spray device comprising the heating of an annular source of shield gas to a temperature above ambient and said shield gas flow being substantially surrounding said effluent in an coaxial manner and the annular source for said shield gas is in a plane normal to said effluent thereby providing said gas flow parallel to the effluent.

2. The method of claim 1 wherein the temperature of said shield gas is at least 500 °F, measured on the centerline of the flow conic at 13 inches downstream from the source of said shield flow.

3. The method of claim 1 wherein the shield gas is a combustible gas comprising a combustion flame and combustion products.

4. The method of claim 1 wherein said shield gas is a flow having at least a laminar segment from the source of said effluent flow.

5. The method of claim 1 wherein said effluent comprises an oxide material.

6. The method of claim 5 wherein said oxide is zirconia or a compound containing zirconia.

7. The method of claim 1 wherein said effluent is deposited onto a substrate to form a coating layer.

8. The method of claim 7 wherein the coated layer has between about 20 and about 200 vertical segmentation cracks per inch.

9. The method of claim 7 wherein a first layer of the first effluent is deposited utilizing a first set of shield gas conditions, and repeating this method at least once with the same or different effluent utilizing the same or a different set of shield gas conditions to obtain multiple coating layers.

10. The method of claim 9 wherein at least one of the coated layers has between about 20 and about 200 vertical segmentation cracks per inch.

11. The method of claim 7 wherein the temperature of the substrate is controlled by adjusting the total gas flow of said shield gas.

12. The method of claim 11 wherein the ratio of the total gas flow of said gas shield to the total gas flow of said thermal spray torch is between about 0.05 to about 2.0.

13. The method of claim 7 wherein the temperature of the substrate is controlled by adjusting the power of said shield gas.

14. The method of claim 13 wherein the ratio of the power of said gas shield to the power of said

thermal spray effluent is in the range of between about 0.5 to about 5.0.

15. The method of claim 7 wherein said substrate is selected from the group consisting of gas turbine, diesel engine, and rocket engine components.

16. The method of claim 1 wherein said annular source comprising a first inner coaxial section for the flow of a first gas substantially surrounding said effluent and a second coaxial outer section for the flow of second gas surrounding said inner flow of said first gas and said second flow is heated to a temperature above ambient and the annular sources for said shield gases are in a plane normal to said effluent thereby providing said gas flows parallel to the effluent.

17. The method of claim 16 wherein the temperature of said dual shield gas is at least 500 °F, measured on the centerline of the flow conic at 13 inches downstream from the source of said shield flows.

18. The method of claim 16 wherein the first gas is an inert gas.

19. The method of claim 16 wherein the second gas is a combustible gas comprising a combustion flame and combustion products.

20. The method of claim 16 wherein said effluent is a reactive material.

21. The method of claim 16 wherein said effluent is deposited onto a substrate to form a coating layer.

22. The method of claim 21 wherein a first layer of a first effluent is deposited utilizing a first set of shield gas conditions, and repeating this method at least once with the same or different effluent utilizing the same or a different set of shield gas conditions to obtain multiple coating layers.

23. The method of claim 22 wherein said first layer is a metallic coated layer and said subsequent layers are ceramic coated layers or mixed metal-ceramic coated layers.

24. The method of claim 23 wherein said layers are selected from the group consisting of zirconia, yttria, hafnia, alumina, chromia, NiCrAlY, CoCrAlY, NiCoCrAlY, CoNiCrAlY, zirconium-based ceramics, ceramics and mixtures thereof.

25. The method of claim 23 wherein at least one coated layer has between about 20 and about 200 vertical segmentation cracks per inch.

26. The method of claim 21 wherein the temperature of the substrate is controlled by adjusting the total gas flow of said shield gas.

27. The method of claims 26 wherein the ratio of the total gas flow of said gas shield to the total gas

flow of said thermal spray torch is between about 0.05 to about 2.0.

28. The method of claim 21 wherein the temperature of the substrate is controlled by adjusting the power of said shield gas.

29. The method of claim 28 wherein the ratio of the power of said gas shield to the power of said thermal spray effluent is in the range of between about 0.5 to about 5.0.

30. The method of claim 21 wherein said substrate is selected from the group consisting of gas turbine, diesel engine, and rocket engine components.

31. The method of claims 1 wherein said heated shield gas comprising a combustible gas material of a carbon-containing gas and an oxidant in which the carbon to oxygen ratio of said shield gas is between about 0.6 to about 1.0.

32. The method of claim 16 wherein said heated shield gas comprising a combustible gas material of a carbon-containing gas and an oxidant in which the carbon to oxygen ratio of said shield gas is between about 0.6 to about 1.0.

33. A thermal gas shield device having an exit end adapted for the effluent of the device comprising a ring of nozzles surrounding the exit end of said thermal spray device with each of said nozzles having

an orifice defined by an enclosed wall with a straight section disposed immediately preceding the exit end of the device adapted for directing at least a laminar segment of a shield gas from the exit end and said shield gas being adapted for coaxially surrounding the effluent.

34. The thermal gas shield of claim 33 wherein said ring of nozzles comprises at least two spaced-apart coaxially disposed rings of nozzles.

35. A gas shield thermal spray device comprising a ring of nozzles surrounding the exit end of said device; means of delivery a fuel gas and an oxidizing gas to said nozzles; means of igniting said fuel and oxidizing gases exiting said nozzles and adapted to deliver a combustible gas and an oxidizing gas to create a stream of combustion flames and combustion products such that an effluent exiting the plasma spray device is coaxially substantially surrounded by said flow of said combustion flames and combustion products.